



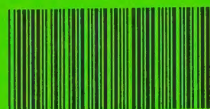
EDGERTON, GERMESHAUSEN & GRIER, INC.

INSTRUCTION MANUAL



MODEL 707 OSCILLOSCOPE

MP MASTER



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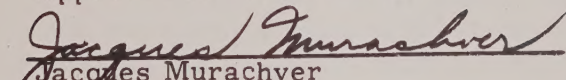
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Instruction Manual
Milli-Mike
Model 707 Oscilloscope

Approved for Publication:


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SPECIAL INSTRUCTIONS

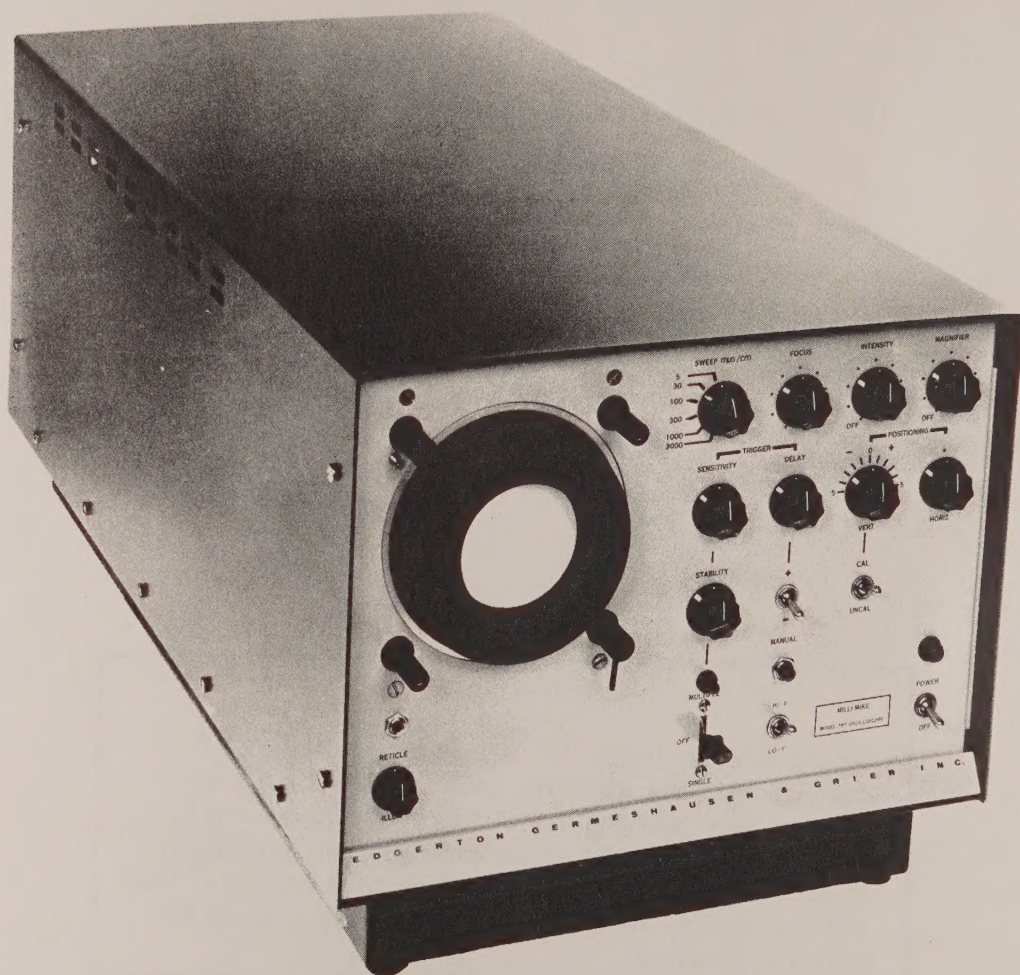
WARNING

Prior to installing the reticle assembly make certain that the shipping lock is completely recessed (see Section 3.2). This allows the cathode-ray tube (KRT) some longitudinal movement. If excessive pressure is applied to the face of the KRT when the reticle is being installed the KRT may be crushed.

OPERATION AT 220 VOLTS AC

The Model 707 Scope is shipped to the user with connections made for 110-volt a-c operation. To operate from 220 volts ac, the following procedure should be observed:

1. Remove the dust cover.
2. Remove the four screws and lockwashers that hold the bottom coaxial coupling capacitors to the rear panel.
3. Unsolder the leads to the coupling capacitors.
4. Remove the bottom capacitors to expose TB801.
5. Move the wire (Insultab 27) from terminal 2 to terminal 1.
6. Replace capacitors and resolder the leads.



Milli-Mike Model 707 Oscilloscope.

SECTION 1

GENERAL DESCRIPTION

This manual contains operating instructions, details of circuit operation, and maintenance data for the Milli-Mike Model 707 Traveling Wave Oscilloscope. Although it is a highly advanced precision instrument, little more instruction is required to operate the Model 707 than for most conventional laboratory oscilloscopes. Persons unfamiliar with its operation should perform the check-out procedures presented in Section 3.4 before attempting measurements.

Submillimicrosecond measurement is made possible in the Model 707 through the use of a special cathode-ray tube, the EG&G Type KR-3C. In this specially developed tube, two metal ribbon helices are used as the upper and lower deflection structures. The input signal to be observed is applied directly by transmission line to either or both helices. Noise generation and signal distortion are minimized because no amplification is used. The deflection helices are part of the transmission line. Construction of the helices is such that the speed of signal propagation along the helices matches the velocity of the cathode-emitted electron stream traveling between the helices, causing the signal and electron stream to be in step. The construction provides extremely high frequency response.

Operating characteristics of the Model 707 are presented in Table 1.

Table 1. Operating characteristics of the Model 707.

<u>EG&G Type KR-3C Cathode-Ray Tube</u>		
Impedance of one deflection helix (2 used)		100 ohms
KRT bandwidth		2000 mc at -3db
Effective spot size (photographic trace width) ^{(1) (2)}		0.002 in.
Sensibility ⁽¹⁾	nominal 55 mv/trace width	
Sensitivity (1)	nominal 10 volts/cm	
Vertical scan (1)		1.0 cm
Horizontal scan (1)		1.5 cm
Electrostatic image magnifier range		1X to 3X
Writing speed (1) (2)	10 ¹² trace width/sec	
Post-deflection-acceleration potential (PDA)	20 kv, or variable from 13 kv down to 3 kv	
Range of vertical calibration		10 volts
<u>Sweep Characteristics</u>		
Maximum sweep speed (1)		5 μ sec/cm
Minimum sweep speed (1)		3000 μ sec/cm
Sweep linearity		5%
Linear length of sweep available (unmagnified)		1.5 cm
Sweep calibration at 20-kv post acceleration		5%
Maximum repetition rate ⁽³⁾		35 kc to 65 kc
Sweep modes: MULTIPLE (repetitive) OFF (disabled) SINGLE (lockout) MANUAL (on command)		
<u>Trigger⁽⁴⁾</u>		
Characteristic impedance of trigger input		50 ohms
Useful trigger synchronization		exceeds 100 mc
Required trigger voltage (minimum)		50 mv
Required trigger voltage for 1.0 μ sec pulse width		0.5 volt
Trigger polarity		+ or -, selectable
Trigger delay		0 to approx 50 μ sec (min)
<u>Delay Line</u>		
Type	Foamflex (Phelps Dodge), 1/2 in. dia.	
Characteristic impedance		50 ohms
Signal delay		60 μ sec (approx)
<u>Other</u>		
Primary power		115/220 volts, 50-60 cps, 300 watts
Dimensions	width - 16-3/4 in.; height - 14-1/4 in.; length - 32 in.	
Weight		130 lb (approx)

¹ For a post-deflection-acceleration potential (PDA) of 20 kv.

² Measured with EG&G Model 850-PH-3 Camera with Royal Pan Film,

Rapid X-ray developer; 75°F, 4 min.

³ Repetition rate falls between 35 kc and 65 kc at 5 μ sec/cm.

⁴ Trigger rates higher than the maximum repetition rates will be counted down.

SECTION 2

DESCRIPTION OF SUBASSEMBLIES

2.1 GENERAL

The Model 707 Oscilloscope consists of six major subassemblies: (1) an indicator chassis, (2) a high-voltage power supply, (3) a low-voltage power supply, (4) a trigger chassis, (5) a sweep generator and (6) a reticle unit. These subassemblies are illustrated in Fig. 1.

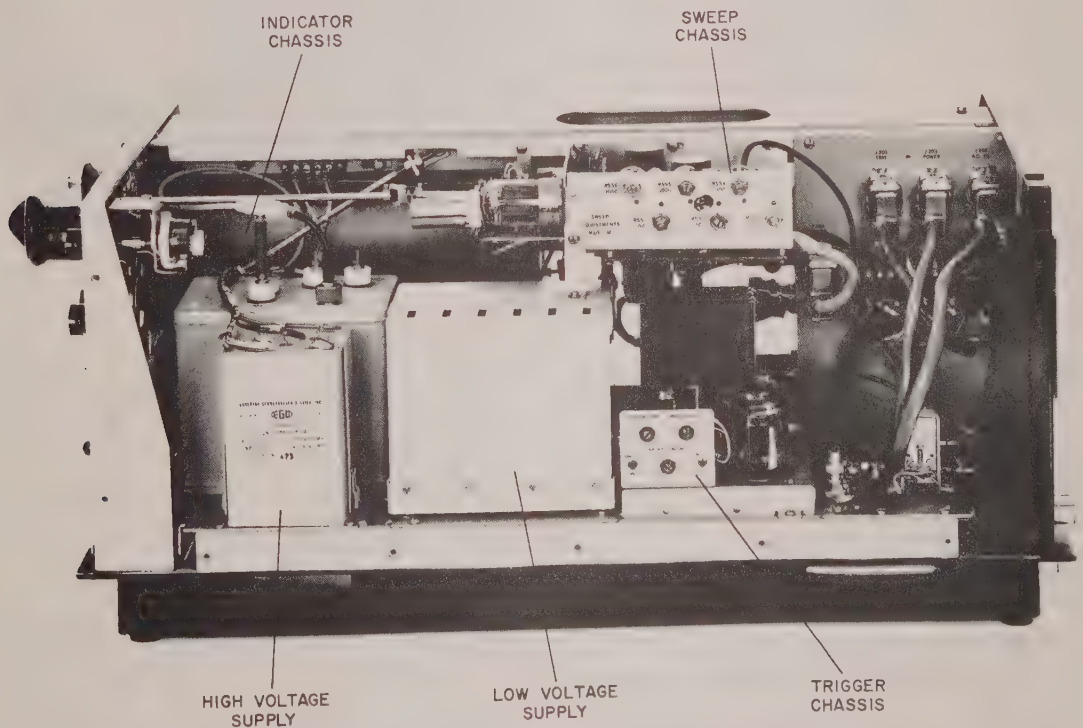


Fig. 1. Subassemblies of the Model 707.

2.2 INDICATOR CHASSIS (KRT PACKAGE)

The cathode-ray tube (KRT) in the Model 707 is supported by a rocking cradle within the indicator chassis, as shown in Fig. 2. The face of the KRT makes direct contact with the spacer tube in the fixed-focus accessory camera (Model 850 with PH-3 or PH-5 film holder) or

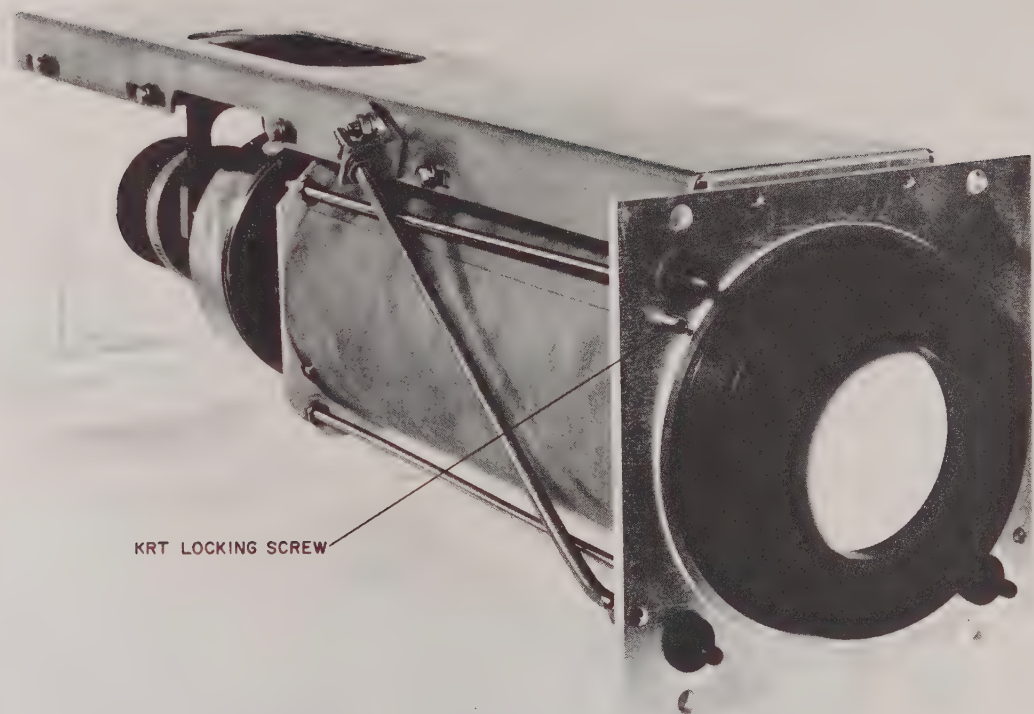


Fig. 2. Indicator chassis.

with the eyepiece, whichever is in use. The high-resolution area of the KRT is 1.0 cm x 1.5 cm and is symmetrical about the electrical center of the KRT. This resolution area is obtained at a post-deflection acceleration (PDA) of 20 kv and provides a trace width of 0.002 in., a sensibility of 55 mv/trace width, and a vertical deflection factor of approximately 10 v/cm. The KRT employs a traveling-wave deflection system for vertical deflection and a single-ended, time-axis deflection system for horizontal deflection. When PDA potentials lower than 20 kv are applied to the KRT, the image will enlarge. For example, at 10 kv the magnification factor is about 2; at 4 kv it is about 3.

2.3 HIGH-VOLTAGE POWER SUPPLY

The high-voltage power supply subassembly shown in Fig. 3 contains an unregulated PS-5A (PDA) Power Supply and a PS-1 Gun Supply. The output of the high-voltage power supply can be altered by varying its



Fig. 3. High voltage power supply.

primary voltage. This can be accomplished by adjustment of the MAGNIFIER control on the front panel. With the control in the extreme counterclockwise position, the output of the high-voltage power supply is 20 kv. When turned slightly clockwise, its output is lowered to approximately 13 kv (in one step) and is thereafter continuously variable down to approximately 3 kv.

The PS-1 Gun Supply provides the operating and control voltages required by the electron gun in the KRT.

2.4 LOW-VOLTAGE POWER SUPPLY

The low-voltage power supply shown in Fig. 4 provides d-c voltages and currents for the positioning, focusing, and associated circuits. The power transformer in this supply also furnishes 115 v ac for operation of the 115-v components when the Model 707 is connected to a 220-v power line. To energize the high-voltage supply and other a-c components the low-voltage power supply must be operating.



Fig. 4. Low voltage power supply.

2.5 TRIGGER CHASSIS

Circuits of the trigger chassis produce a fixed trigger function which drives a sweep generator. Input to the trigger chassis is through a 50-ohm (characteristic impedance) tapoff. Input signals as low as 50 mv will trigger the unit. A trigger delay incorporated in the trigger chassis acts like a sweep delay and has an approximate range of 0 to 50 musec (min). The trigger circuitry can be made to lock (synchronize) on frequencies beyond 100 mc by adjusting the STABILITY, SENSITIVITY, DELAY, and HI-F LO-F controls. (These front-panel controls, in addition to controls for plus or minus trigger polarity, manual trigger and lockout, are part of the trigger chassis.) The trigger chassis is shown in Fig. 5.

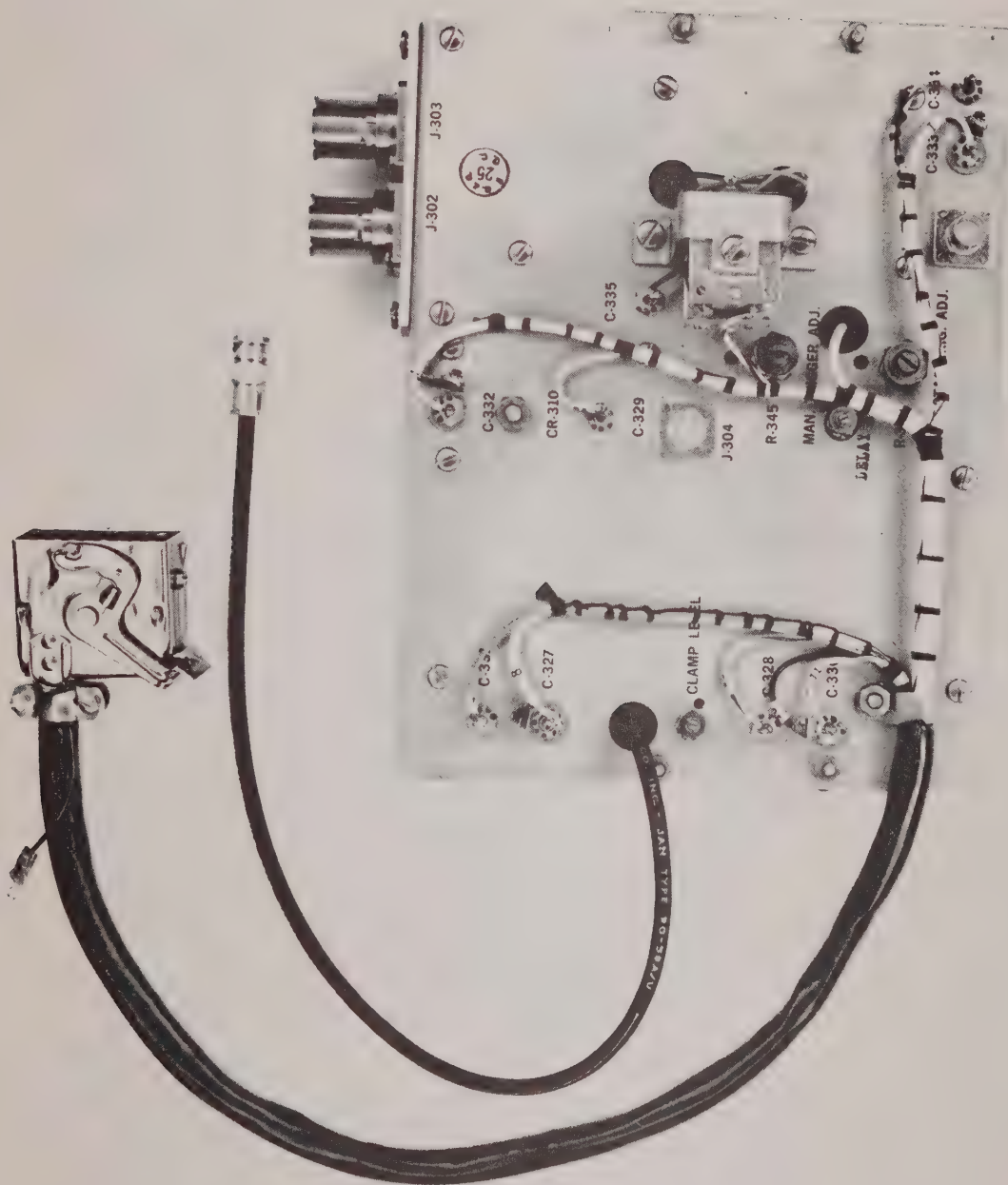


Fig. 5. Trigger chassis.

2.6 SWEEP GENERATOR

The sweep generator, Fig. 6, receives the trigger signal from the trigger chassis and generates sweep and intensity pulses. This circuit provides a selection of six calibrated sweep speeds: 5, 30, 100, 300, 1000, and 3000 $\mu\text{sec}/\text{cm}$. The sweep speeds are adjusted at the factory and calibrated for a sweep and linearity accuracy of 5% (some non-linearity will be evident at the beginning and end of each sweep). Note that calibration of the sweep speeds will not be true (sweep speeds will be increased) when the magnifier control is in use.

2.7 RETICLE

The reticle assembly shown in Fig. 7 contains a 5X magnifier, a beam-splitting mirror, and an illuminated reticle. The reticle and beam-splitting mirror are arranged so that when the reticle assembly is placed against the front face of the KRT, the reticle appears in the same focal plane as the KRT image. Rough focus of the reticle eyepiece can be obtained by moving the lens barrel in or out. Critical focus can then be obtained by rotating the lens as required.

The reticle is a 1.0-cm x 1.5-cm field area ruled into 1-mm squares, thus providing a 10-mm x 15-mm graticule. (This matches the high resolution area of the KRT display at 20-kv PDA potential.) The center line of the horizontal grid lines, as well as the vertical grid lines that mark the fifth and tenth millimeter divisions of the reticle, are dotted to facilitate measurements. For example, in the 5 $\mu\text{sec}/\text{cm}$ sweep speed position, each square represents 0.5 μsec on the time axis (with MAGNIFIER in the OFF position). The illumination of the graticule is controlled by the RETICLE knob.

When used as a close-up lens, the quality of the magnifier permits useful photographs to be taken of a repetitive signal trace with the superimposed graticule. For example, good quality photographs can be made under these typical conditions:

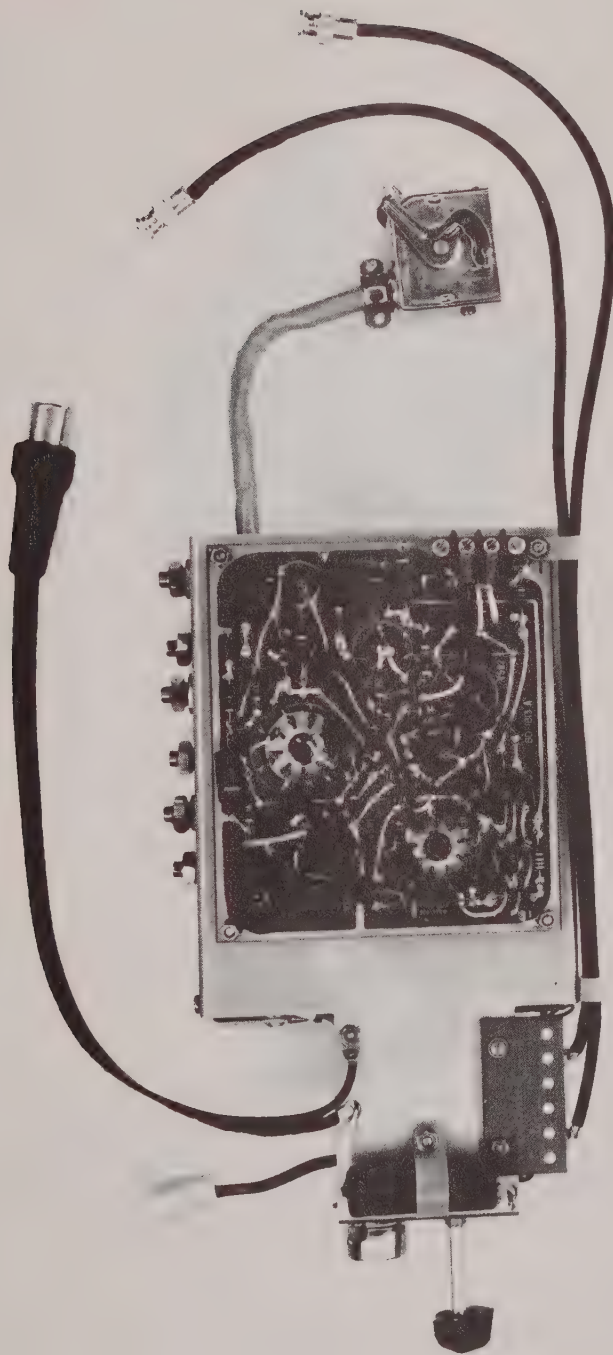


Fig. 6. Sweep generator.

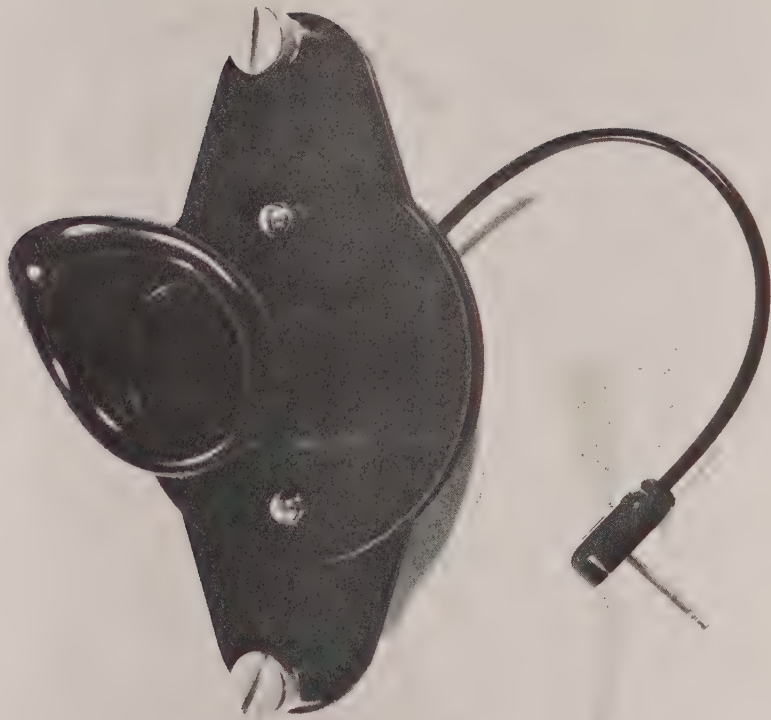


Fig. 7. Reticle assembly.

Camera (1)	Standard Polaroid (held against magnifier)
Film	Polaroid 3000
Exposure	1/10 second
Effective aperture	f/4.8
Sweep repetition rate	125 sweeps per second or higher
Sweep speed	any
Magnifier control	off

Other exposure parameters may be selected to suit the operator's particular requirements.

¹A fully integrated system is available in the EG&G Model 850 Camera. This camera, which mounts directly over the face of the KRT, has a highly corrected f/0.7 lens, a precision fixed-focus 1:1 optical system, and a built in 5X viewer. Addition of either the PH-3 cut-film holder, or the PH-5 Polaroid film holder completes the camera system.

If a standard camera with removable back is used, the focus adjustment can be greatly simplified by employing a feeler gauge. The width of the gauge can be determined as follows:

- a. With the camera lens at infinity insert a ground glass in the focal plane of the camera.
- b. Place the camera lens flush against the scope magnifier.
- c. With a signal on the scope face, adjust the magnifier to obtain the sharpest image on the ground glass.
- d. Take a very accurate measurement of the space between the magnifier ring and magnifier shoulder; then, make a gauge machined to this measurement.
- e. Thereafter, set the magnifier to its correct position by means of the gauge each time the camera is to be used.

2.8 SIGNAL COMPONENTS

The signal components, other than the KRT itself, include:

- a. Two 100-ohm terminators (externally mounted on the rear panel).
- b. Four coupling capacitors.
- c. One delay line (approx 60 μ sec), 50-ohm characteristic impedance.

CAUTION

Care must be exercised when mating the General Radio connectors used with the Model 707. The 100-ohm signal input and output connectors have a small-diameter center conductor, while the 50-ohm trigger and delay-line connectors have a larger diameter center conductor, as shown.



100 OHMS



50 OHMS

Do not try to mate a 100-ohm connector directly to a 50-ohm connector. When a 50-ohm line is to be connected to a 100-ohm line, the 50/100-ohm connector adapter (BB-1982) must be used.

The 100-ohm terminators are of coaxial design and provide a true resistive termination over the bandwidth of the KRT. The coupling capacitors which have a capacitance of 0.25 μ f, are mounted coaxially in a cylindrical housing to maintain a characteristic impedance of 100 ohms. They are used to isolate the signal from the d-c potential that is applied to the deflection helices for vertical positioning. These capacitors should be bypassed when the lower frequency limit is to be dc instead of approximately 10 kc. The 50/100 ohm connector adapter permits the output of the 50-ohm delay line to be applied to one 100-ohm signal helix.

2.9 ACCESSORIES

The accessories which are standard equipment for the Model 707 are shown in Fig. 8.

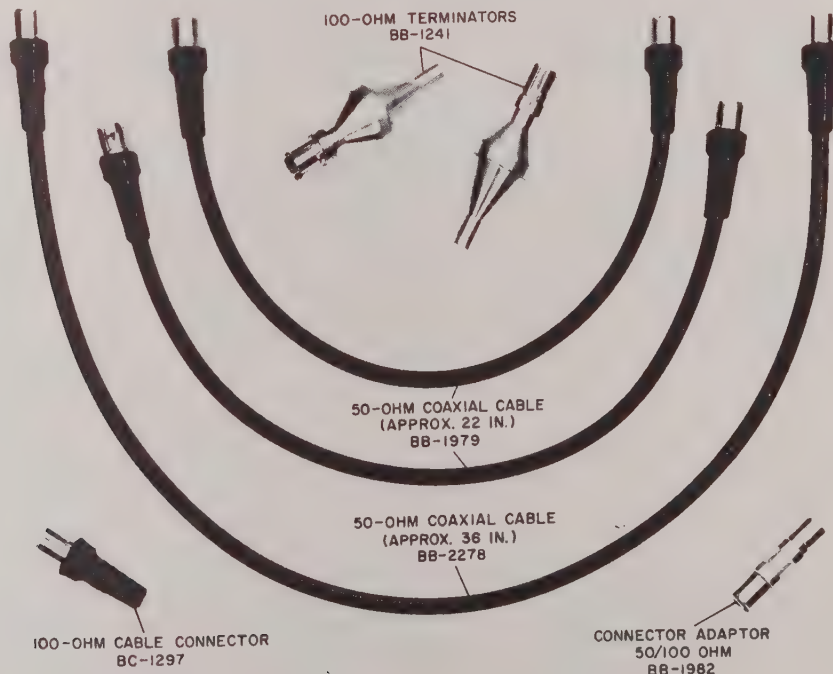


Fig. 8. Accessories included with Model 707.

SECTION 3

OPERATING INSTRUCTIONS

3.1 FRONT PANEL CONTROLS

Operating controls and the functions they perform are described in this section (refer to Fig. 9).

<u>Control Designation</u>	<u>Function</u>	<u>Index No.</u>
ILLUM	Controls the amount of reticle illumination.	15
FOCUS	Controls the focusing of the beam (trace)	5
INTENSITY	Adjusts intensity of the beam. (Turn to OFF when the Model 707 is unattended.)	6
MAGNIFIER	Controls the amount of PDA potential applied to the KRT. In the OFF position, PDA is 20 kv. A slight clockwise rotation of the control will lower the PDA potential in one step to approximately 13 kv. Additional clockwise motion will gradually decrease it to about 3 kv. As the PDA potential is decreased, the size of the image increases. Approximately 3X magnification can be obtained by full clockwise rotation of the MAGNIFIER. (Sweep calibration is not valid when MAGNIFIER is activated.)	8

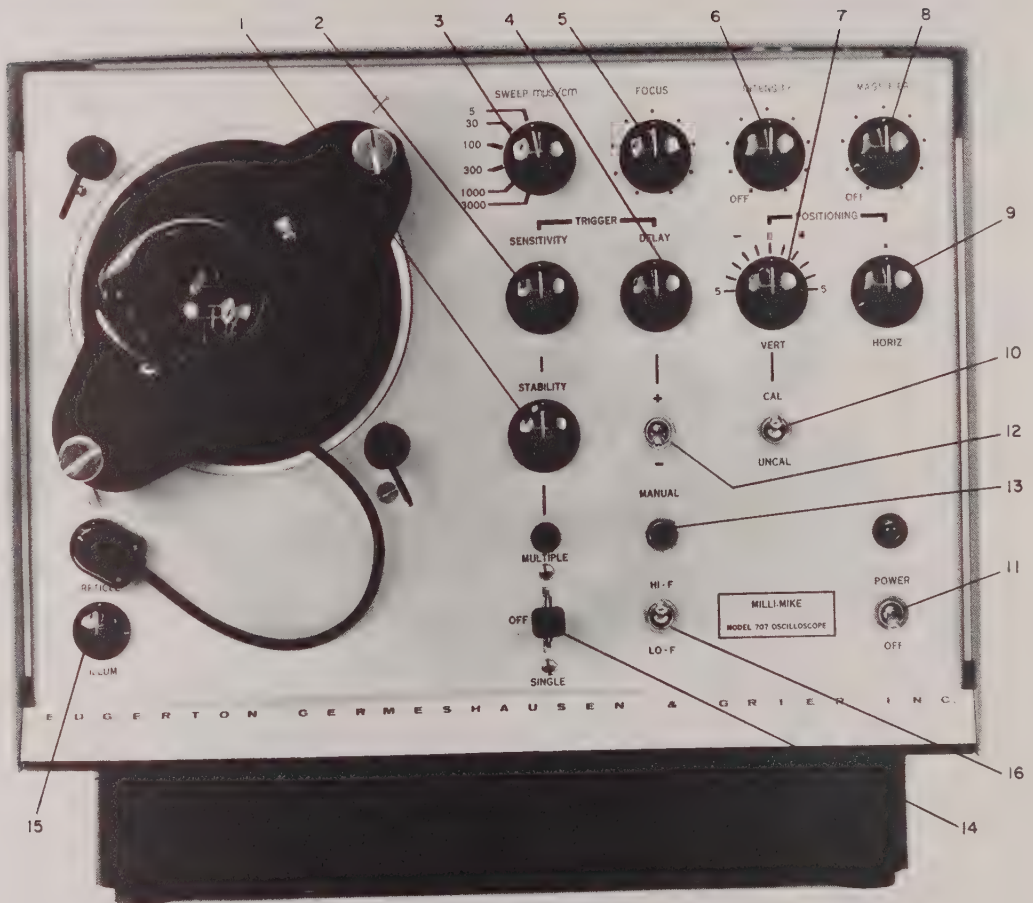


Fig. 9. Front panel controls.

<u>Control Designation</u>	<u>Function</u>	<u>Index No.</u>
SWEEP $m\mu s/cm$	Selects calibrated sweep speeds of 5, 30, 100, 300, 1000 and 3000 $m\mu sec$ per cm. When the MAGNIFIER is activated, the sweep speeds are not calibrated.	3
POSITIONING controls:		
VERT	Controls the vertical positioning of the trace.	7
CAL	Allows the vertical position of the trace to be adjusted over a calibrated 10-volt range. Graduated in one-volt increments for pulse-height measurements.	10
UNCAL	Permits a greater range of uncalibrated vertical positioning.	10
HORIZ	Controls the positioning of the sweep in the horizontal direction.	9
TRIGGER controls:		
SENSITIVITY	Controls the amount of trigger amplification.	2
STABILITY	Controls the sweep stability. With this control turned completely clockwise, the sweep will be free-running.	1
DELAY	Controls the starting time of the sweep with respect to the incoming trigger (sweep delay).	4
+ -	Selects trigger polarity	12

<u>Control Designation</u>	<u>Function</u>	<u>Index No.</u>
MULTIPLE	With the lever in this position, the sweep will occur when triggered from an external source, or when triggered internally.	14
OFF	Disables sweep.	
SINGLE	With the lever in this (spring-loaded) position, the scope will be triggered by the first trigger signal received. Only one sweep will result and the sweep circuit will then be locked (as indicated by lighting of neon lamp above the word (MULTIPLE)). No additional sweep can occur in this mode of operation.	14
MANUAL	Triggers a single sweep each time the button is pushed with the lever switch in MULTIPLE position and STABILITY control fully counter-clockwise.	13
HI-F/LO-F	Helps obtain best lock-in when viewing repetitive signal display.	16
POWER OFF	Controls primary power to instrument.	11

3.2 PREPARATION FOR USE

Prepare the Model 707 for use as follows:

- a. Position the Model 707 in a convenient location with respect to the circuitry to be observed. (Lift the instrument by means of the two handgrips located on each side of the oscilloscope. The handgrips are recessed in the base.)

NOTE

The handgrip cutouts are also used for ventilation and should not be blocked.

b. Free the KRT:

1. Turn the slotted shank of the shipping lock (located below the upper left-hand camera bolt) clockwise so that the lock recesses completely into the front panel.
2. The KRT should now be free to move back. Check by applying light thumb pressure to the KRT dome. **DO NOT APPLY PRESSURE DIRECTLY TO THE FACE OF THE KRT. Damage will result!**

c. If the EG&G recording camera is to be mounted, proceed as in step d (omit step e); if the reticle assembly is to be employed, omit step d.

d. To install the EG&G Recording Camera:

1. Remove the round spacers from the upper left-hand and lower right-hand camera-mounting studs. (These spacers are used only with the reticle assembly.)
2. Replace with two lugs which are attached to studs provided for this purpose on the rear of the scope.
3. Mount the camera flange over the four studs.
4. Bring the front spacer of the camera into firm contact with the face of the spring-mounted KRT by carefully tightening the lugs.

e. Attach the reticle assembly to the Model 707 as follows:

1. Make certain that the upper left-hand and lower right-hand camera-mounting studs are fitted with round reticle spacers. Note that one end of the reticle spacer has a recess. This end should be fitted to the camera-mounting stud.

CAUTION

When attaching the reticle spacer, it is very important that the recessed end of the spacer be placed facing the front panel so that the recess fits over the shoulder of the camera-mounting stud. If the spacer is mounted in the reverse direction, it may not be possible to focus on the display or to eliminate parallax.

2. Mount the reticle assembly to the two reticle spacers and secure.
3. Plug the reticle illuminator cable into the RETICLE jack. Note that the reticle eyepiece can be focused roughly by moving the barrel in or out, and then focused critically by rotating the barrel. If it becomes necessary to align the reticle grid with the trace, loosen the two acorn nuts on the reticle assembly. Then, while looking through the eyepiece, slew the circular plates until the desired position is reached. Carefully tighten the nuts with a spin-tight wrench.
- f. Place the power switch in the OFF position and turn the INTENSITY and STABILITY controls completely counter-clockwise.
- g. Connect the power cord to 115v, 50-60 cps. (For conversion to 220-v operation, see "Special Instructions" in the front of the Manual.)
- h. Turn the power ON and allow the instrument to warm up about one minute before use. The scope becomes fully stabilized in 15 to 30 minutes.

NOTE

If reshipment becomes necessary, the KRT should be locked in its forward position by turning the slotted shank of the shipping lock counterclockwise until the tube is held forward firmly. (Test by applying light thumb pressure on the dome. The KRT should not move.)

CAUTION

If the shipping lock is not completely recessed (tube unlocked) when the Model 850 camera (or any similar camera) is placed on the camera mounting lugs the shipping lock will prevent the camera from being seated properly.

WARNING

When the reticle is to be mounted, make certain that the shipping lock is completely recessed since there is no stop to prevent the face of the KRT from being crushed if excessive pressure is applied.

3.3 SIGNAL APPLICATION

On the Model 707 all signal connectors are located at the rear of the instrument (Fig. 10). The feed-through trigger tapoff has two closely spaced connectors (marked TRIGGER). Because the tapoff is electrically symmetrical, triggering signals may be applied to either connector. The connectors for the KRT are located under the word SIGNAL. Signals are applied to the connectors marked IN and pass through a coupling capacitor to the input end of the TW deflection helix of the KRT. The upper and lower connectors are associated with the upper and lower helices, respectively. Those marked OUT are connected via a coupling capacitor to the output end of the respective TW helix. When the signal is not to be taken from the scope to feed an external circuit the output connectors should be terminated into 100-ohms.

terminators to prevent reflections that would distort the signal waveform. A positive signal applied to the upper connector marked SIGNAL IN will produce a positive (upward) deflection on the face of the KRT. Applied to the lower SIGNAL IN connector, a positive signal will result in a negative (downward) deflection.

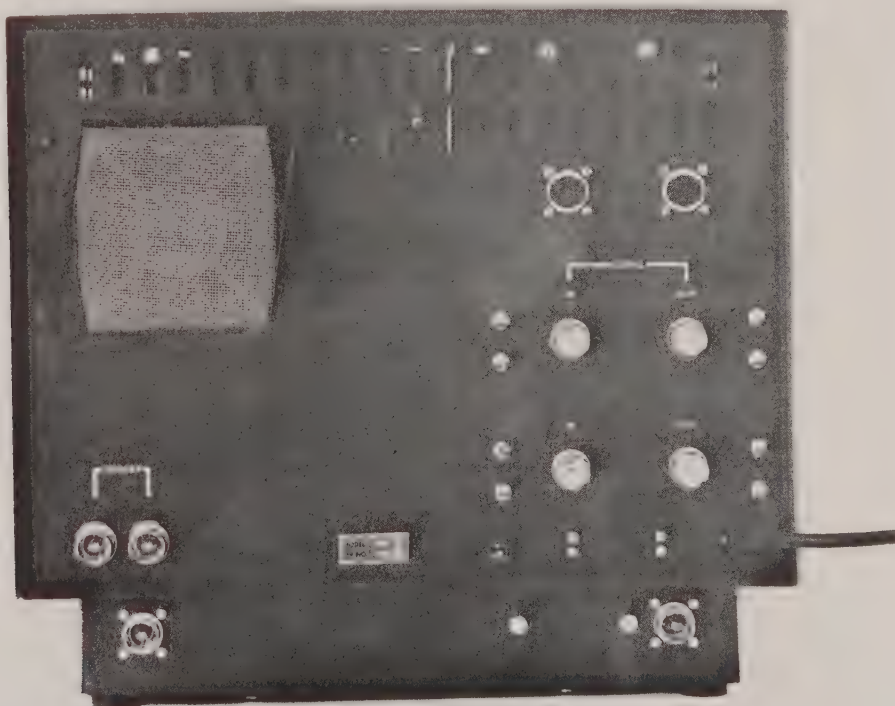


Fig. 10. Rear panel connectors.

To make a directly coupled signal connection to one helix, the coaxial cables connected to the upper helix should be disconnected from the associated coupling capacitors inside the oscilloscope. These connectors should then be inserted through the two holes located immediately above the SIGNAL connectors and fastened by screwing in the fastening nuts.

A 60-musec delay line is mounted in the base of the instrument with its connectors located on the base, below the rear panel.

The TW deflection helices in the KRT have a characteristic impedance of 100 ohms and all connectors and cables connected to the helices match this impedance. Inputs to the trigger circuit and the delay line have a characteristic impedance of 50 ohms.

3.4 CHECK-OUT PROCEDURES

Personnel having no prior experience with the Model 707 should perform the procedures described below. After preparing the Model 707 for operation as described in Section 3.2, and when the instrument has been warmed up:

- a. Turn the STABILITY control (1, Fig. 9) completely clockwise.
- b. Move the lever switch (14) to the MULTIPLE position.
- c. Select a medium sweep speed (e.g., 300 mμsec/cm) with the sweep speed selector (3).
- d. Turn the MAGNIFIER control (8) to the OFF position.
- e. Turn the VERT (7) and HORIZ POSITIONING (9) controls to their middle positions (pointers straight up).
- f. Increase the intensity (6) and focus baseline (5). Do not use excessive intensity. .
- g. Lower the lever switch to its OFF position and the trace will disappear. The sweep circuit is now disabled. In this mode neither sweep signals nor intensity pulses are supplied to the KRT.
- h. Lower the lever switch to the SINGLE position (spring-loaded position). A single sweep will occur, thus producing a single trace. The sweep is initiated by the first pulse from the free-running trigger circuit to reach the sweep system. Subsequent pulses are blocked from the sweep circuit. The lockout condition is indicated by the neon lamp positioned directly over the word MULTIPLE.

- i. Return the lever switch to its OFF position, thus deactivating the lockout circuit. A single trace can again be produced by lowering the lever to the SINGLE position.
- j. Move the lever switch to MULTIPLE. The trace should be visible. The sweep circuit is now gated by trigger pulses from the free-running trigger circuit. Perform this operation at all sweep speeds, then return to the 300 $\mu\text{sec}/\text{cm}$ position.
- k. Turn the STABILITY control completely counterclockwise. This adjustment will prevent the trigger from running free and the trace will disappear.
- l. Press the MANUAL button (13). A single trace will be produced each time the button is pressed.

The scope is now ready to display signals.

- a. Set controls as follows:

MULTIPLE	(up position)
TRIGGER DELAY	full CCW
TRIGGER SENSITIVITY	full CCW
SWEEP $\mu\text{s}/\text{cm}$	300
$\begin{array}{c} + \\ - \end{array}$	same polarity as triggering pulse

- b. Turn STABILITY control CW until a trace appears. Then, back off the control until the trace fades out.
- c. Apply a signal to the instrument, using coaxial cables and other accessories as described in Section 5. Note that a millimicrosecond pulse generator is used. Pulses not in the millimicrosecond region are too slow to be viewed effectively with the Model 707 Oscilloscope. If possible, select fairly high repetition rates, greater than 100 pulses

per second, and a pulse duration greater than 10 millimicroseconds (a 50- μ sec pulse of 4 to 8 volts is recommended for this check-out procedure).

- d. With the lever switch in its MULTIPLE position, SWEEP at 300, and the TRIGGER DELAY control (4) rotated completely counterclockwise, adjust the sweep STABILITY so that the sweep is not quite free-running. Then adjust the TRIGGER SENSITIVITY control (2) as required to trigger the sweep.
- e. With a pulse in view, adjust the SENSITIVITY and the STABILITY controls. These adjustments will have some influence on the pulse's position on the time axis.
- f. Adjust the TRIGGER DELAY control. This control allows the operator to delay the start of the sweep (trace) within the range of zero to approximately 50 μ sec.
- g. Activate the magnifier by turning the MAGNIFIER control clockwise. Refocus and adjustment of the beam intensity may be necessary.

NOTE

The calibration, as indicated by the SWEEP speed switch, holds true only when the MAGNIFIER is in its OFF position.

- h. Manipulate the VERT and HORIZ POSITIONING controls and notice that these have the conventional effect on trace displacement.
- i. For gross measurement of the pulse amplitude display, the VERT control knob is calibrated over a range of 10 volts. To employ the calibration, move the toggle switch below the VERT control to the CAL position. (This calibration function is independent of the magnifier.)

3.5 SWEEP SPEED ADJUSTMENTS

Each of the calibrated sweep speeds can be adjusted by using the appropriate controls on the sweep chassis. These controls are:

- R551 only for 5 mps/cm sweep
- R552 and C536 for 30 mps/cm sweep
- R553 and C538 for 100 mps/cm sweep
- R554 and C539 for 300 mps/cm sweep
- R555 and C540 for 1000 mps/cm sweep
- R556 and C541 for 3000 mps/cm sweep

The correct sweep speed can be obtained by adjustment of the potentiometers. Linearity can then be obtained by adjustment of the trimmer capacitors. Because of interaction between sweep and linearity controls these adjustments should be repeated until no interaction is evident.

The adjustment procedure requires that several cycles of a very accurate signal, preferably a sinewave, be displaced on the scope. The period of one cycle of the signal can be determined from its frequency and then compared to the time scale of the display.

For example, with the SWEEP control at 100 mps/cm one cycle of a 100-mc signal should occupy exactly one of the one-millimeter squares on the reticle. At this sweep setting, each one-millimeter square represents 10 mps/cm, which is also the period of the 100-mc signal.

Note that some non-linearity will exist at the beginning of the trace. This is characteristic of all scopes since the spot requires a finite time to accelerate at the beginning of each sweep. In lower-speed scopes this non-linearity may not be evident. In the case of the Model 707 the non-linear portion of the trace occupies only 1/2 to 1 cm of the sweep. Hence, to overcome this condition, the operator need only reposition the sweep with the HORIZ control so that subsequent sweep speed adjustments are made on the essentially linear portion of the sinewave.

The procedure just described should be performed at each sweep setting. Since these are such sensitive adjustments they should be undertaken only when absolutely necessary.

SECTION 4

CIRCUIT DESCRIPTION

4.1 GENERAL

The high-frequency response of the Model 707 is achieved by means of a traveling wave deflection system. In typical capacitor-plate deflection systems, frequency response is limited by transit time of the beam electrons through the plates. This difficulty is overcome in the Model 707 by propagating the signal pulse along a helix which lies parallel to the beam axis. The helix pitch is designed so that the speed of signal propagation down the tube matches the beam velocity. Two such helices are used in the EG&G Type KR-3C KRT. Either helix may be driven singly or the pair may be used to carry push-pull signals.

Sweep operation is initiated by the trigger-chassis circuitry shown in the block diagram of Fig. 11. The countdown stages permit viewing of repetitive signals beyond 100 mc while the trigger pulse generator and delay establish the triggering time of the sweep generator. Trigger pulses may be prevented from reaching the sweep generator by activating a lockout stage.

The sweep and intensity pulse generator, shown in Fig. 12, is driven by the trigger pulse generator illustrated in Fig. 11. Signals from the sweep and intensity stages are applied to the sweep driver and from there to the sweep output tubes. A clamp circuit controls the intensity level and a cancellation pulser limits the width of the intensity pulse.

In other respects the circuitry of the Model 707 is generally similar to most laboratory oscilloscopes.

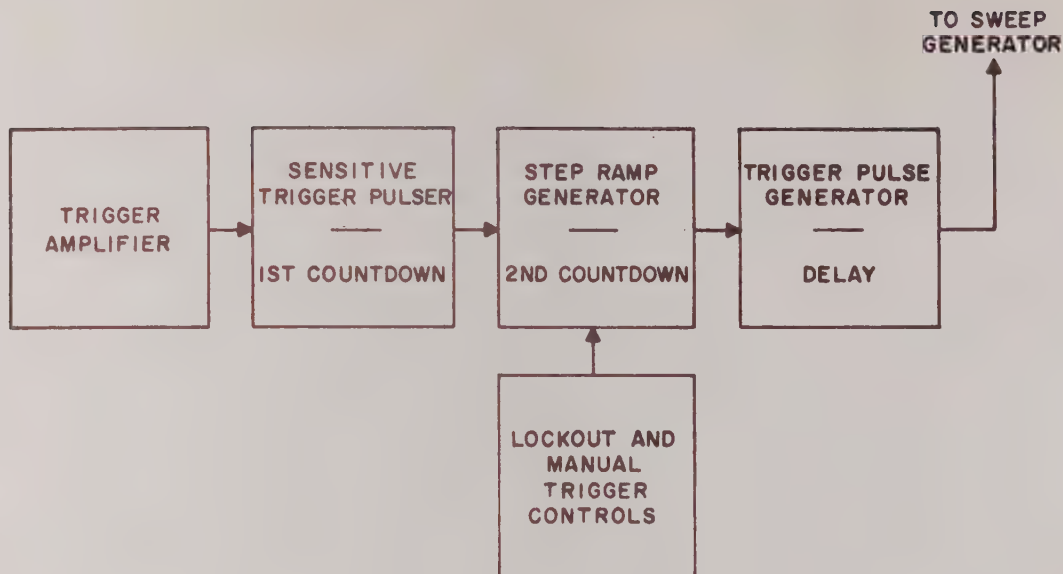


Fig. 11. Trigger chassis block diagram.

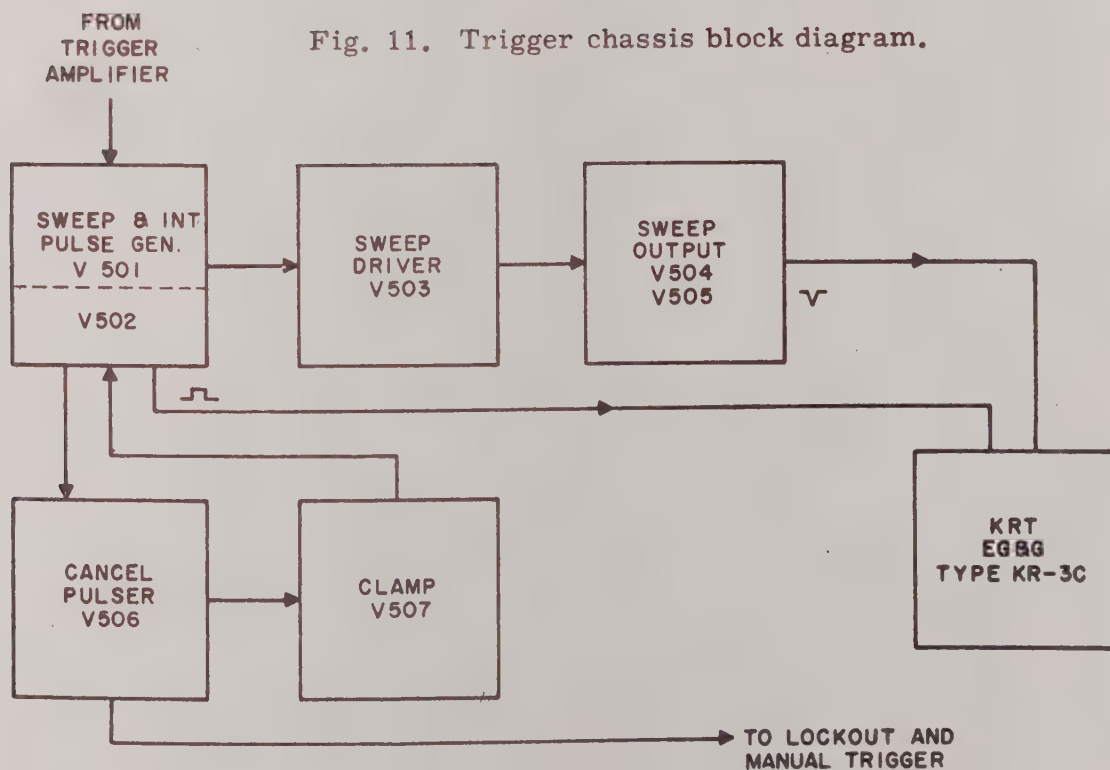


Fig. 12. Sweep and intensity pulse generator block diagram.

4.2 TRIGGER CHASSIS

4.2.1 Functions and General Description

The trigger chassis performs two major functions. It taps off sufficient energy from the signal line to trigger its various circuits, and produces an output pulse large enough to trigger the intensifier-sweep assembly.

Circuits in the trigger chassis are shown in Fig. 13 and include the following:

- a. Trigger tap-off
- b. Overvoltage clamp network
- c. Trigger amplifier
- d. Sensitive trigger pulser (1st countdown stage)
- e. Interstage trigger control network
- f. Step ramp generator (2nd countdown stage)
- g. Trigger pulse generator (delay)

4.2.2 Trigger Controls

4.2.2.1 Panel Controls

A number of front panel controls are associated with the trigger chassis. The STABILITY control (R113) controls the repetition rate of the first countdown stage. The HI-F/LO-F toggle switch (S107) provides additional repetition-rate control of the first countdown stage to permit lock-in above 100 mc. The trigger threshold control designated SENSITIVITY (R111) in conjunction with the STABILITY control provides a true trigger threshold mainly for pulse sync.

For pulse sync at low repetition rates STABILITY is set fully clockwise, switch S107 is placed at LO-F, and SENSITIVITY is adjusted for the required sensitivity or threshold setting.

The trigger polarity switch (S101) is also associated with pulse sync. It establishes the polarity at which sync is obtained. The MANUAL trigger push button (S103) provides a means of triggering the sweep manually regardless of external circuitry or the position of S104, the MULTIPLE/OFF/SINGLE function switch.

In the MULTIPLE position, S104 controls the second countdown stage and permits the Model 707 to be used as a high-frequency synchronized oscilloscope. The OFF position of the switch disables the second countdown. In this position an external signal cannot trigger the scope. However, the MANUAL push button will override the OFF setting for external signals. The SINGLE position of S104 allows the sweep to be triggered once and then blocks out the second countdown. Thereafter, the circuit cannot be triggered unless S104 is returned to the OFF position.

To obtain pulse sync the SENSITIVITY and STABILITY controls must first be adjusted so that the sweep is not free-running. Function switch S104 may then be operated.

The point on the output pulse of the step-ramp generator at which the trigger-pulse generator triggers is selected by a DELAY control (R103). The output of the trigger pulse generator triggers the intensifier-sweep assembly.

4.2.2.2 Chassis Controls

In addition to the panel controls just described there are a number of controls on the chassis (Fig. 13) which are preset and normally do not need readjustment. An interstage trigger level control (R347) is used to adjust the trigger pulse fed from the sensitive trigger pulser to the second countdown stage. This control is adjusted in conjunction with the SENSITIVITY and STABILITY controls for maximum sync at about 50 mc. It must never be adjusted so that the sweep triggers when S104 is in the OFF position. This would indicate an overdriven condition.

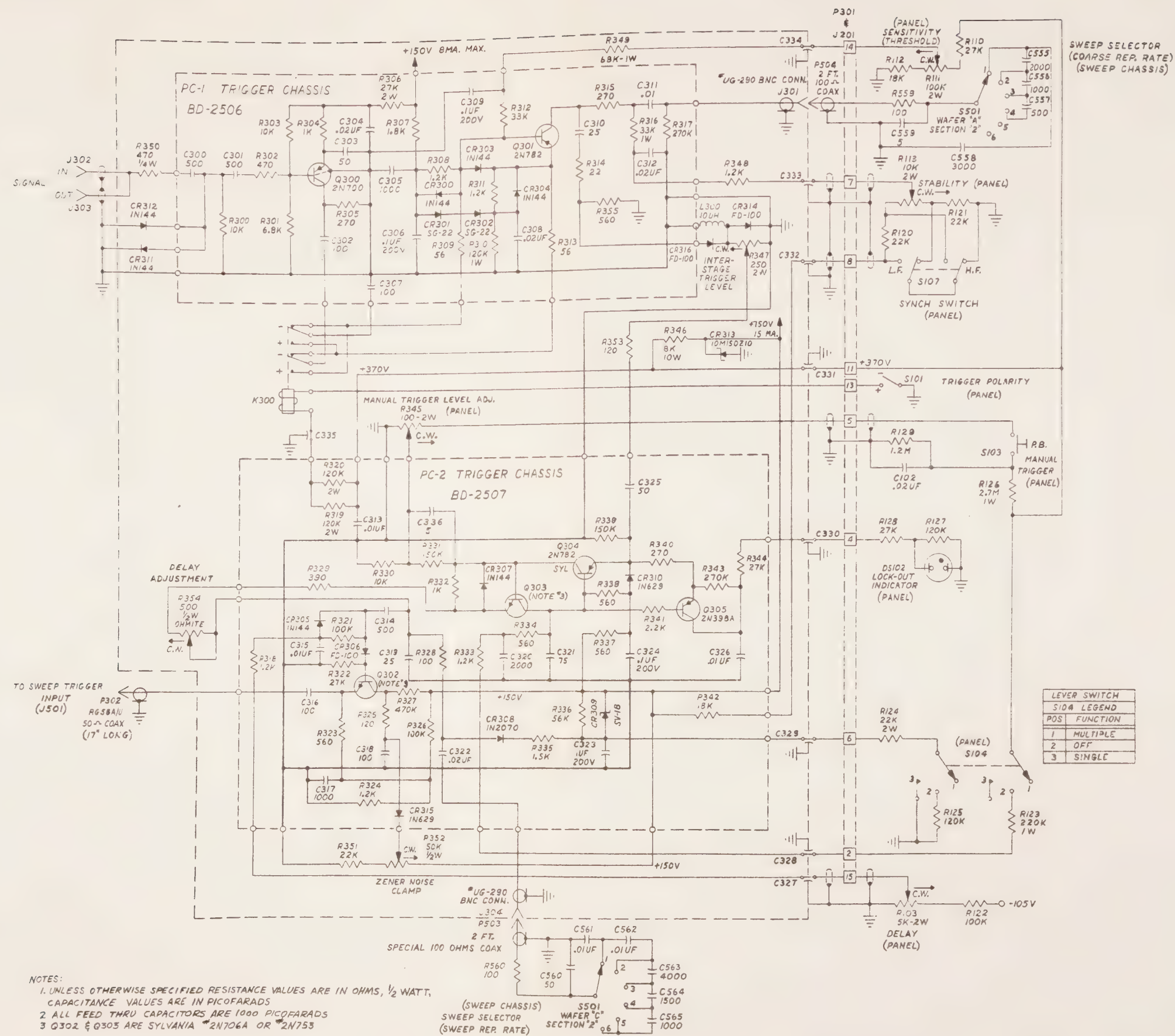


Fig. 13. Trigger chassis schematic.

A manual trigger level control (R345) is used to adjust the pulse from the manual trigger to the second countdown stage. It is adjusted so that when S104 is at OFF the trigger level is just sufficient to override the OFF position.

A zener-noise clamp (R352) on the collector of the trigger pulse generator (Q302) is adjusted for minimum jitter when R354 is set for maximum delay. This adjustment can be made on high-frequency repetitive operation or on pulse operation. The latter is recommended because of its relative operating simplicity. A pulse of about 50 μ sec and greater than 2 volts should be used.

In addition to the controls just described there are two controls associated with the trigger circuits that are located on the sweep chassis as part of the SWEEP speed selector. A coarse repetition rate control (S501, wafer A, section 2) varies the first countdown in proportion to the sweep repetition rate, allowing higher frequency sync capabilities with increase of sweep speed. A sweep repetition rate control (S501, wafer C, section 2) controls recovery of the second countdown stage. This, in turn, controls the sweep repetition rate thus permitting higher sweep repetition rates for faster sweeps.

4.2.3 Trigger Circuit Operation

A portion of the signal applied to J302 (Fig. 13) is developed across R350 for the trigger amplifier. An overvoltage clamp network comprised of R350, C300, CR311 and CR312 limits power fed to the trigger amplifier to safe values for signal levels not exceeding one hundred volts. Since R350 is only a 1/4-watt resistor, power applied to the clamp network must be limited or burn-out may occur.

The trigger signal is fed via C301 and R302 to the base of trigger amplifier Q300. This stage operates as a class-A, common-emitter amplifier so that all signals applied to the base, regardless of polarity,

are amplified and inverted at the output (collector). Coupling time constants impart to the amplifier a low-frequency cut-off point that is relatively high (about 100 kc) and establish a unity current gain at about 150 mc. Published data for the 2N700 transistor (Q300) show 1000 mc as the upper frequency limit. However, design is such that the circuit operates well in excess of this frequency.

The output of Q300 is coupled through C302 to a polarity-selector relay, K300. Relay K300 is controlled by the front panel trigger polarity switch, S101. (Caution should be observed when making measurements on this circuit since in the normally off condition the relay coil is at +370v dc in relation to the chassis.) From K300 the signal is fed to transistor Q301 which operates in the avalanche mode. Operation in this mode can be compared to thyatron behavior in that the transistor can be made quite stable on standby or can be free-run as a relaxation oscillator. Control of Q301 is provided as follows:

<u>Control</u>	<u>Location</u>	<u>Function Controlled</u>
SENSITIVITY (R111)	front panel	emitter-to-base bias
S501, wafer A, section 2	sweep chassis	coarse repetition rate
STABILITY (R113)	front panel	fine repetition rate
HI-F/LO-F (S107)	front panel	high frequency sync boost

As noted earlier S501, wafer A, section 2, provides coarse control of the repetition rate. It places the repetition rate near optimum sync on frequencies such that presentation at the selected sweep speed is reasonable. Controls R111 (SENSITIVITY), R113 (STABILITY), and S107 are all interdependent in their action. Bias on the emitter base of Q301 is controlled basically by R111. This control can be overridden, by setting S107 to HI-F and rotating R113 in a clockwise direction. At these settings the apparent action of R111 is to control the repetition rate or to provide sync control for high frequency sync. Normal

procedure is to set S107 at LO-F and to adjust both R111 and R113. The relative positions of these controls depend on whether a free-run or single-shot mode is desired. The free-run condition is used for synchronization on sine waves or high-duty-cycle pulse trains; the single-shot mode is used where a stable condition on standby is desired. To obtain the latter condition R113 is turned fully clockwise; then, R111 is adjusted until the circuit is just off free run. This combination of settings produces the most sensitive trigger condition. Other positions of the two controls will produce trigger characteristics that are optimum for a particular signal.

Transistor Q301 generates a positive pulse having a rise time of about one millimicrosecond. The output is obtained from the collector and is coupled through C310 and R314 to a wave-forming and control network consisting of CR316, L300, CR314, and R347 (interstage trigger level adjustment).

When used for high-frequency sync some r-f energy feeds through Q301 and may cause pre-trigger of the second countdown stage, a condition that causes sync jitter. When Q301 is operated in the free-run mode, jitter is prevented by CR316 which decouples the r-f feed-through. Self-bias is established by CR316 as it rectifies the output pulse from Q301. When the circuit of Q301 operates as a single-shot trigger no bias is developed and a maximum pulse is passed from Q301 to the second countdown stage.

Diode CR314 and inductance L300 form a clamp circuit which limits voltage across R347. Regardless of the output level from Q301 a control can be obtained. The level and duration of the pulse delivered to the second countdown are very important since they can degrade synchronization by causing delay and jitter.

The interstage trigger level adjustment (R347) provides a means of controlling the amplitude of the pulse to the second countdown stage. The position of this control also has an effect on jitter. It is normally adjusted with the system set for high-frequency sync and with an input frequency of 50 mc on the signal line. The control is positioned to obtain optimum sync with lowest jitter. At no time should the circuit trigger when function switch S104 is in the OFF position. When the circuit is operated at a low repetition rate (synchroscope operation) and with S104 at OFF, a sweep should not be triggered.

The second countdown stage consisting of Q303, Q304, and associated circuits performs a number of functions. Basically, it is a single-shot complementary symmetry multivibrator. It is normally in a biased-off condition.

Control of the second countdown stage is provided as follows:

<u>Control</u>	<u>Location</u>	<u>Function Controlled</u>
MANUAL (S103)	front panel	push button sweep trigger
Function switch (S104):	front panel	
MULTIPLE		repetitive sweep
OFF		sweep disabled
SINGLE		single trace with lock-out
S501, wafer C, section 2	sweep chassis	sweep repetition rate
Manual trigger level adj (R345)	trigger chassis	manual trigger pulse level

The complementary symmetry pulser is unusual in that Q304 is operated in the avalanche mode. When operated in this manner a voltage is applied to the collector-base system such that a zener condition is obtained (i.e., the collector-to-base diode is back-biased to the point at which it is reverse conducting). A reverse bias is applied to the emitter-base diode which prevents conduction. Zenering of the collector to base of Q304 limits the voltage applied to Q303 to a level below the zener level of Q303.

With the pulser in its standby position current flows from the +150v dc supply through R337, CR310, and R339 to ground. The voltage drop across CR310 is applied to the emitter-base junction of Q304 as a reverse bias. Current also flows from the +150v dc supply through R337, R338, the base-to-collector junction of Q304 (zenered), R331, and the parallel combination consisting of R330 and R345 to ground. The voltage drop across R338 bucks-out some of the voltage drop across CR310 thereby reducing the applied bias. This reduction occurs only when zener current is being drawn through Q304. The zener voltage drop (Q304 base to collector) is applied between the base and collector of Q303. The emitter-to-base ignition level of Q303 (effectively 0.5 volt) prevents current drain through Q303.

The complementary symmetry circuit can be triggered in two ways; either by means of a trigger pulse obtained from Q301 (and controlled by interstage trigger level R347), or by means of the MANUAL trigger push button (and controlled by R345).

The position of function switch S104 determines the operating mode of the complementary symmetry circuit. In the SINGLE position the circuit is a triggered, single-shot multivibrator. It operates as follows:

A trigger is applied to avalanche transistor Q304 in the form of a positive pulse to the emitter. The transistor avalanches producing a sharply rising pulse (about one μ sec) on the collector. This pulse feeds through the base-emitter junction of Q303 to a load composed of R329, R354, C319, R328, C322, R560, C560, and the capacitor selected by S501.

Current flowing through the emitter-base of Q303 produces current in the collector circuit. This flow is applied to the base-emitter junction of Q304 which saturates and further energizes Q303. As a result, a higher voltage is developed at the emitter of Q303. The duration of the pulse developed at the emitter of Q303 is determined

by the effective loop gain of Q303 and by the quantity of energy stored in the capacitors of S501, wafer C, section 2. If either value increases the pulse duration will increase. Greatest energy storage is obtained with the SWEEP selector at its slowest setting (3000). Energy storage also determines the repetition rate of the sweep since the sweep circuit is a slave of the circuit just described. The pulse circuit begins recovery when the current through Q303 is no longer sufficient to energize Q304. During recovery the capacities in the emitter circuit of Q303 discharge in a negative direction. A voltage drop appears across R332 which reverse-biases the emitter-base of Q303. Since there is no zener current being drawn at this time through the collector-base junction of Q304, the full reverse bias developed across CR310 is applied to the emitter-base of Q304 thus blocking energizing pulses from the first countdown stage. The circuit cannot fire again until the zener current has been re-established. This happens when the load capacitors have discharged.

With the function switch in the OFF position a positive voltage is fed to R123. A current is thereby developed through R123, R333, R334, R338, and R337 to the +150v dc supply. The voltage drop across R338 increases the reverse bias on the emitter-base junction of Q304 beyond the point at which the trigger pulse obtained from the first countdown can trigger Q304.

With the function switch in the OFF position a current is passed through R336, CR309, R124, and R125 to ground. The current establishes a voltage level on C323 about 18 volts below the 150v dc supply level. If the zener level of Q304 is considered to be between 20 and 30 volts, the back-bias on CR308 is then the difference between 150 volts minus 18 volts (or 132) and 150 volts minus the zener voltage. Hence, the back-bias on CR308 is a minimum of 2 volts or a maximum of 12 volts.

When the function switch is operated in the SINGLE position a much heavier current is passed through CR309. Very little change occurs in voltage on capacitor C323 but a high current is made available. In addition, positive voltage is removed from R123. This removes excess bias from the emitter-base of Q304 thus arming Q304 so that it can again be triggered by the next pulse from the first countdown stage.

With the function switch in the SINGLE position, triggering of Q304 results in the action previously described but with the following difference. The current which determines pulse length comes not only from the storage capacitors but flows through CR308, R335, and R124 to ground as soon as the voltage on the wave-forming network rises to a point positive in relation to the voltage set on C323. Sufficient current is thus passed through transistor Q303 to permit Q304 from dropping out of saturation. As long as the function switch is held in the SINGLE position the circuit will remain sealed-out.

To provide a visual monitor of the seal-out condition a neon pilot lamp located on the panel is energized by current from Q305. Transistor Q305 is energized by power flowing through Q303.

The pulse voltage developed on the emitter of Q303 is determined by the zener voltage of Q304. Since the zener voltage varies between individual transistors a means of regulating the pulse must be provided. This function is performed by a waveforming network which provides a step ramp for application to series diode CR306. The bias on CR306 (as controlled by delay control R103) determines the level of the step ramp that is necessary for CR306 to conduct.

Potentiometer R354 (delay adjustment) is provided to enable adjustment of the step ramp so that a control for the full delay range (100 μ sec) can be obtained on sweep speeds 5 and 6 (30 μ s/cm and 5 μ s/cm). The pulse generated at the emitter of Q303 is essentially a square pulse. It is fed through R329 and R354 to C319 where partial integration of the

rise front occurs. The pulse then passes through R329 and C322 to two feet of 100-ohm coaxial line (connecting the trigger chassis to the sweep chassis), through pulse-terminating resistor R560 to integrating-capacitor C560, and through the particular capacitor bank selected by S501, wafer C, section 2.

Initially, the pulse rise applied to the waveforming network sees a resistive divider. Voltage at the junction of CR306 and C314 is a small fraction of that generated at the emitter of Q303. As the power flow continues voltage builds on the integrating capacitors until a step ramp is formed. The step is very fast and the ramp is controlled by the values of the integrating capacitor and the resistive series.

The total value of the integrating capacitors increases as SELECTOR switch S501 is adjusted for slower sweeps. Therefore, the available controllable sweep delay increases approximately in proportion to the decrease in sweep repetition rate.

Sweep delay is provided by diode CR306 with the reverse bias on the diode controlled by DELAY control R103. The bias voltage determines the point on the step ramp pulse at which CR306 will conduct. This establishes the point in time at which a signal is delivered to the base of Q302.

The trigger pulse generator consists of Q302 operated in the avalanche mode. The output pulse is obtained from the emitter and delivered through a 17-in. length of RG58A/U to the trigger input on the sweep chassis. To assure noise-free operation a zener noise clamp (R352) is provided. The correct setting of this control is important. It exists when voltage at the arm of R352 is no more than 10 volts and no less than one volt below the collector-to-base zener level of Q302. A zener-knee noise level in excess of one volt can cause jitter.

The repetition rate of Q302 is completely controlled by the second countdown stage. The output of Q302 is a positive pulse having a rise time on the order of one μ sec and a voltage amplitude at the sweep trigger input of at least 10 volts.

Power for the trigger chassis is obtained from the low voltage supply. A regulator zener diode, CR313, is provided to regulate critical circuits on the trigger chassis.

4.3 SWEEP GENERATOR

4.3.1 Trigger and Intensity Pulse Generator

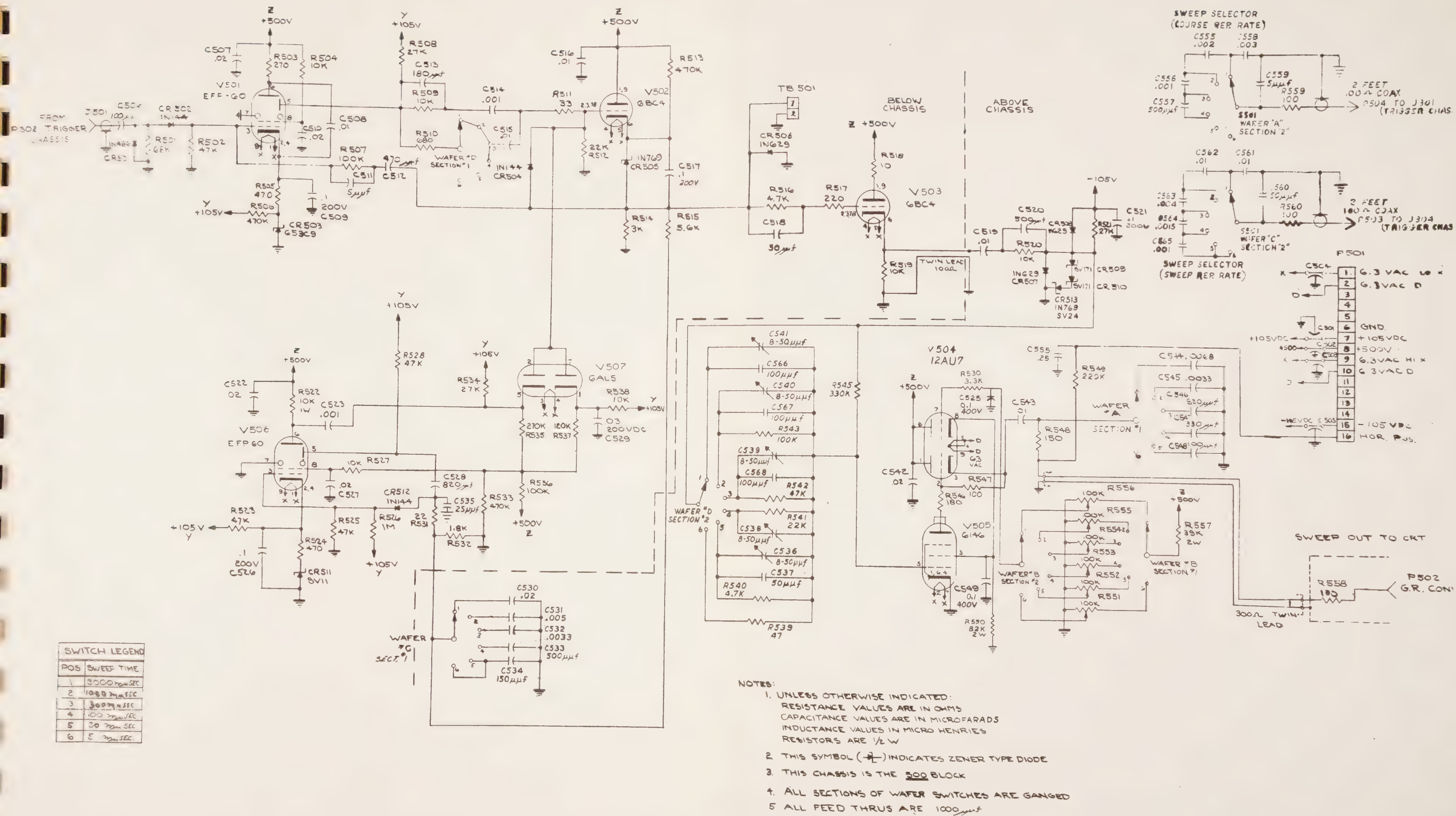
Tubes V501 and V502 produce a fast-rising intensity pulse and a drive pulse for the sweep output (see Fig. 14). Both V501 and V502 are normally biased to cut-off. When V501 is triggered, dynode and anode currents begin to flow, and a positive-going output is developed at the dynode. This output is fed to the grid of V502, a cathode follower. Part of the output of V502 is fed back to the grid of V501 through an RC network comprised of R507, C511, and C512 thereby establishing a regenerative loop. Additional regeneration is provided from anode to cathode by C508. A fast-rising intensity pulse is developed at the cathode of V502 which is fed to the grid of the KRT. The rise time of this pulse is approximately 18 μ sec. Its height is controlled by one half of clamp diode V507. The level of the intensity pulse is determined by the cathode bias on V507 which clamps the grid and cathode levels of V502. The intensity pulse has an amplitude of approximately 105v. This circuit generates a basic pulse length of approximately 20 μ sec. without any cancellation. A cancellation pulser, V506, and the other half of clamp diode, V507, determine the intensity pulse length for each particular sweep. Wafer D, section 1 of the SWEEP selector is part of the intensity pulse compensator and is switched into the circuit by the front panel SWEEP selector.

4.3.2 Sweep Driver Stage

Tube V503, a cathode follower, provides sweep drive. The voltage at the grid of the KRT is also fed to the grid of V503 through a network comprised of R516, R517, and C518. This network establishes a current drive of sufficiently high input impedance to hold loading to a minimum while supplying enough energy to the grid to assure operation.

4.3.3 Sweep Output Stage

The output of V503 is fed to the grid of V505, the sweep output tube, through a clamping network composed of CR508, CR509, and CR510. This network clamps the pulse at approximately 50v and never allows the grid of V505 to go above zero bias. Tube V505 is normally near cutoff until driven. The network C520 and R520 and the networks on wafer D, section 2, of the SWEEP selector constitute the drive-pulse linearity compensation for changing tube characteristics. One half of V504 is used as a dynamic plate load for V505 resulting in rapid recovery time for this circuit. The other half of V504 is a cathode follower which supplies screen voltage for V505. The sweep speed is determined by the value of screen voltage and the amount of capacity in the plate circuit of V505. Sweep speeds are adjusted by the potentiometers that control the screen voltages. The potentiometers are selected by wafer B of the SWEEP selector for each sweep speed. The plate capacitors (wafer A) are discharged at a linear rate when V505 conducts, thus producing a linear ramp. The negative-going pulse is fed to the single-ended sweep plate on the cathode-ray tube to produce the time base. The horizontal positioning voltage is also applied to the sweep plate through decoupling resistor R549 on the same lead used for the sweep pulse. Because a charge appears on C543 a sweep position change will be noted with a change in sweep duty cycle (repetition rate).



POS	SWEEP TIME
1	3000 μSEC
2	1000 μSEC
3	300 μSEC
4	100 μSEC
5	30 μSEC
6	5 μSEC

Fig. 14. Sweep and intensity pulse chassis schematic.

4.3.4 Intensity Pulse Cancellation Stage

Cancellation pulser V506 is triggered by the output of V502 through an integrating network composed of R515 and the capacitors mounted on wafer C of the SWEEP selector. The RC time constant of this network determines when V506 will be triggered which, in turn, establishes the length of the intensity pulse. Tube V506 generates a negative pulse which limits the width of the intensity pulse. The anode output of V506 is used for cancellation while the dynode output triggers the lock-out circuit.

Tube V506 is normally cut off. When it is triggered, current begins to flow and regeneration is established by the feedback from dynode to grid. A negative pulse, produced at the anode, is fed to the cathode of one half of V507, thus clamping the grid of V502. This circuit action reduces the intensity pulse to zero voltage level.

4.4 POWER-SUPPLY CIRCUITS

The high-voltage power supplies, consisting of the PS-5A Power Supply (unregulated) and the PS-1 Gun Supply, are of conventional circuit design. Because they are sealed units and must be replaced as units if defective, no circuit description is included here. The low-voltage power supply, Fig. 15, follows conventional transformer power-supply design.

4.5 INDICATOR CIRCUITS

Electrode voltages (+1600 to -1750 volts dc) are furnished by the PS-1 Gun Supply, as shown in Fig. 16. The PDA potential is derived from the PS-5A Power Supply. At the PDA potential of 20 kv, the image displayed on the KRT is not magnified. The image can be enlarged, if necessary, by lowering the PDA potential. This is accomplished by lowering the input voltage on the primary of the PS-5A supply by means of the MAGNIFIER controls, S106 and R104. The controls have

a common shaft and are arranged so that a slight clockwise motion closes S106, shorts out R110, and lowers the PDA potential in one step to approximately 13 kv. Additional rotation of the control (R104) gradually lowers the PDA potential to 3 kv.

4.6 CHASSIS INTERCONNECTION

The various chassis and components of the Model 707 scope are interconnected as shown on the wiring diagram, Fig. 17.

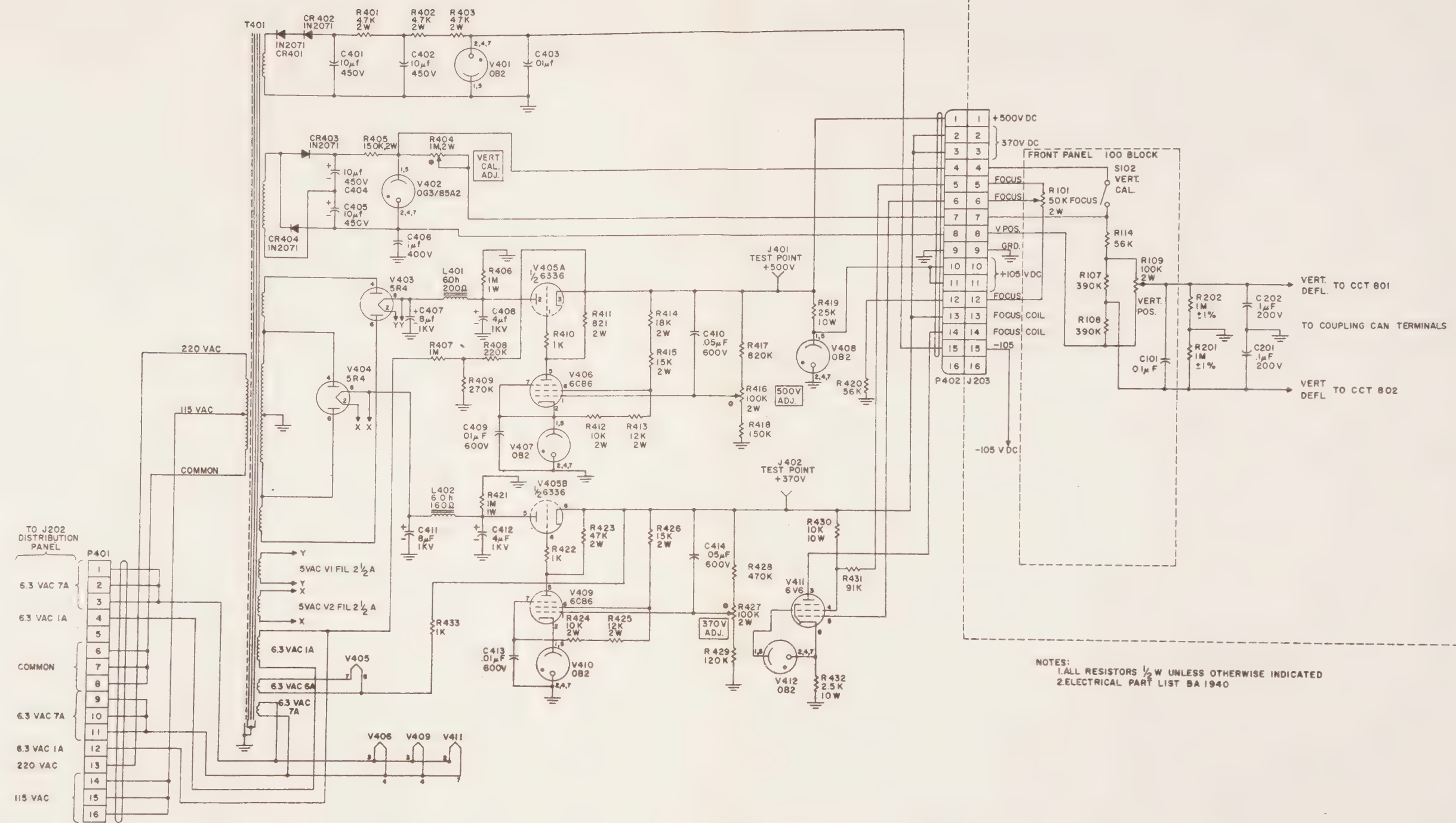


Fig. 15. Low voltage power supply schematic

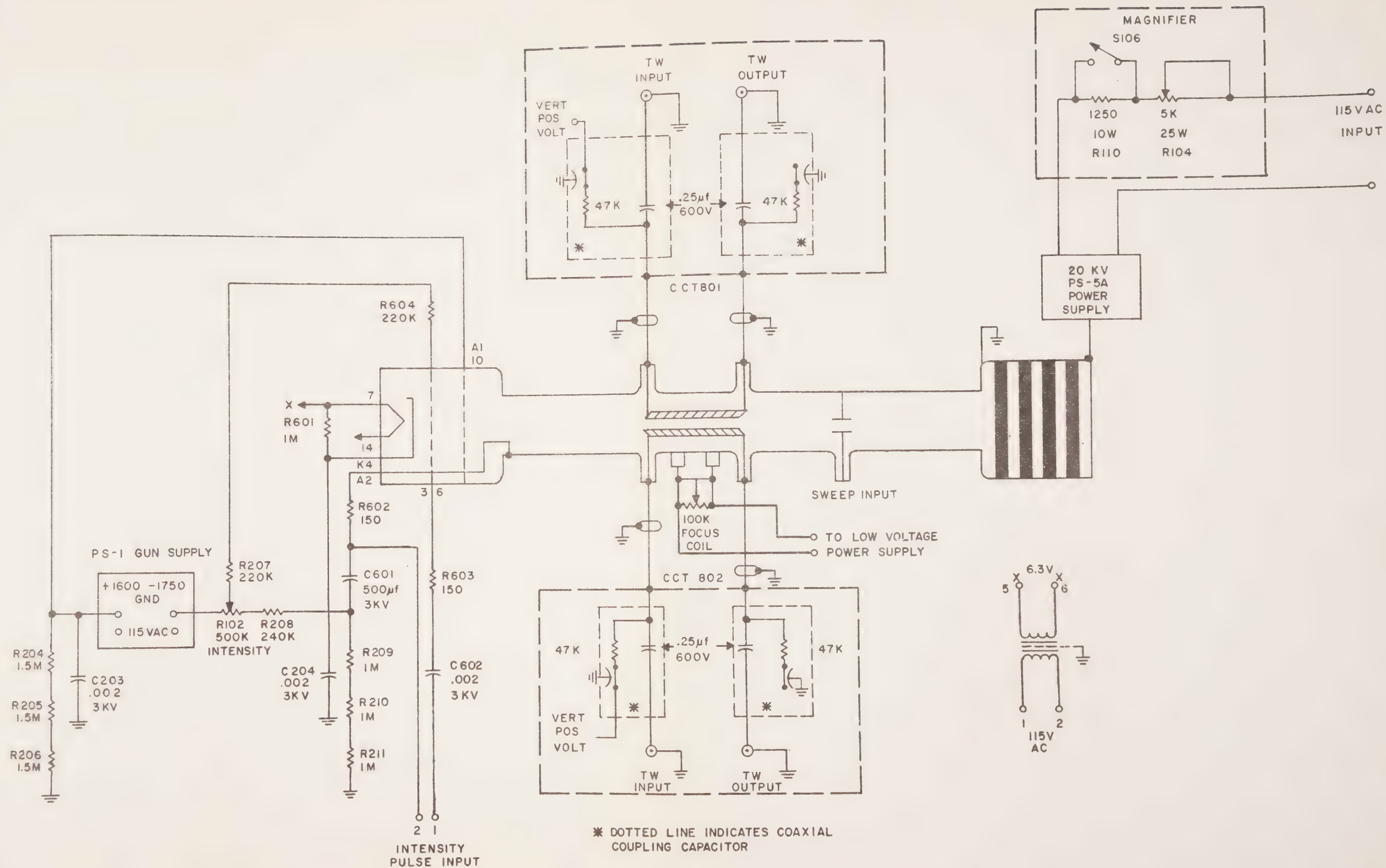


Fig. 16. Indicator chassis.

SECTION 5

BASIC CABLING SYSTEMS

5.1 GENERAL

The impedance values of circuits in the Model 707 are such that it is possible to produce a reasonably clean (low VSWR) cabling system. Without this characteristic, full use could not be made of the instrument's ability to display continuous-wave as well as single-transient and repetitive phenomena. These values include the 100-ohm impedance of the deflection helices, and the 50-ohm impedances of the trigger tapoff and 60- μ sec delay line.

When used with a passive pulse-inverting network, such as the EG&G Type No. TR-6 Pulse Inverter, the deflection structures of the KRT lend themselves to balanced push-pull drive. The integral delay cable in the Model 707 has a 50-ohm impedance, as does the trigger tapoff system. Note that the trigger tapoff does not load the signal cable with 50 ohms when the signal is used to trigger the scope; instead, a small amount of energy is extracted from the signal and is then passed through the trigger tapoff. This energy is amplified before being used to trigger the sweep circuitry of the instrument.

5.2 TRIGGER ARRANGEMENTS

Normally, when viewing or photographing signal displays on the Model 707 the sweep and intensity functions are blanked (scope not free-running) until such time as the signal reaches the deflection helices. The time interval between application of a trigger signal, and the start of the sweep and the increase in intensity (unblanking) will vary from 50 to 100 μ sec. The actual time depends upon the amplitude, duration, and rise time of the triggering signal.

To obtain a visible presentation the signal to be displayed must appear on the deflection helices from 50 to 100 μsec after a trigger signal has been applied to the scope input. This time delay can be accomplished by triggering the 707 with the signal (only a small fraction of the signal is extracted for triggering). The signal is then passed through a high quality coaxial delay line to the deflection helices as illustrated in Fig. 18.

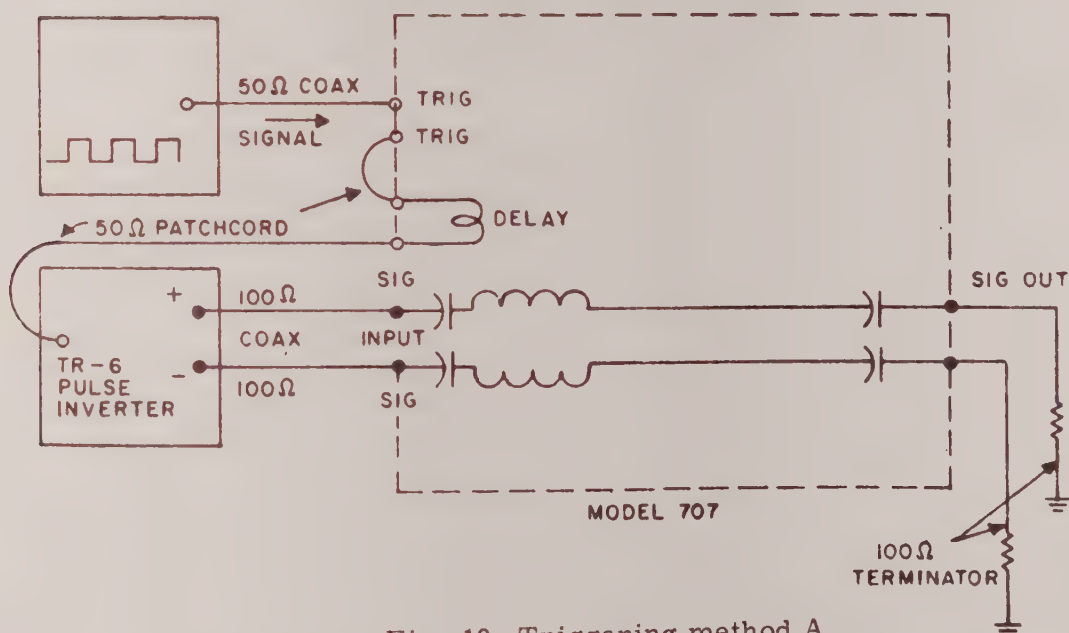


Fig. 18. Triggering method A.

Another triggering arrangement is shown in Fig. 19. In this system a trigger is applied to a device whose output is to be displayed on the Model 707. The same trigger is also used to trigger the scope. If the delay time (the turn-on time) through the device is between 50 and 100 μsec , and trigger cable L1 is short, then the output of the device can be applied directly to the deflection helices. In this type of system no additional delay is required. However, if the device turn-on time is more than 100 μsec , then cable L1 should be made long enough to delay the trigger sufficiently.

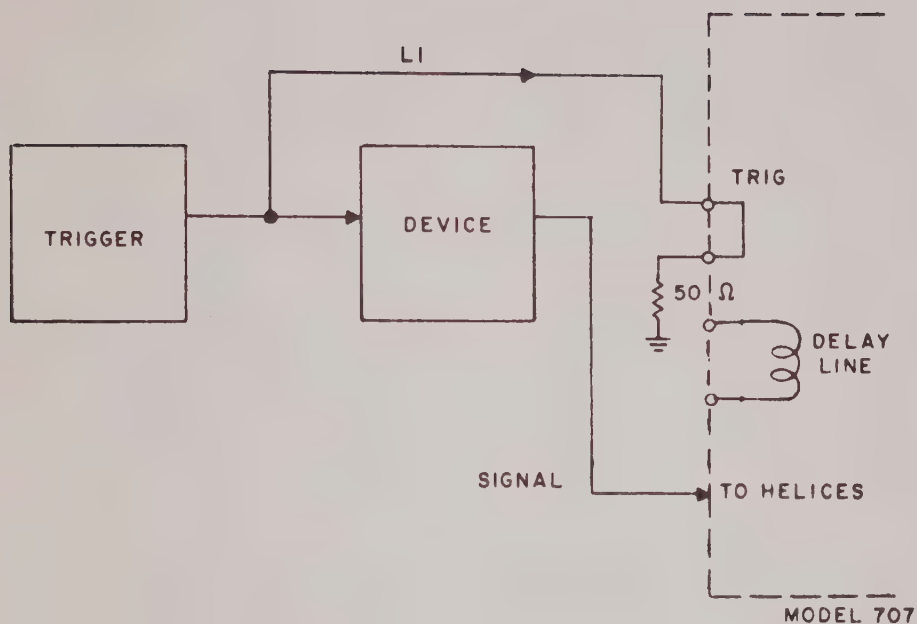


Fig. 19. Triggering method B.

A triggering arrangement useful for short pulses is shown in Fig. 20. If the two-way transit times in cables L1 and L2 are greater than the duration of the signal, the resultant reflections will not interfere with the signal display. Note that the one-way transit time (delay) through RG-8/U cable is 1.52 $\mu\text{sec}/\text{ft}$. Three such patch cables are supplied with the 707 Scope.

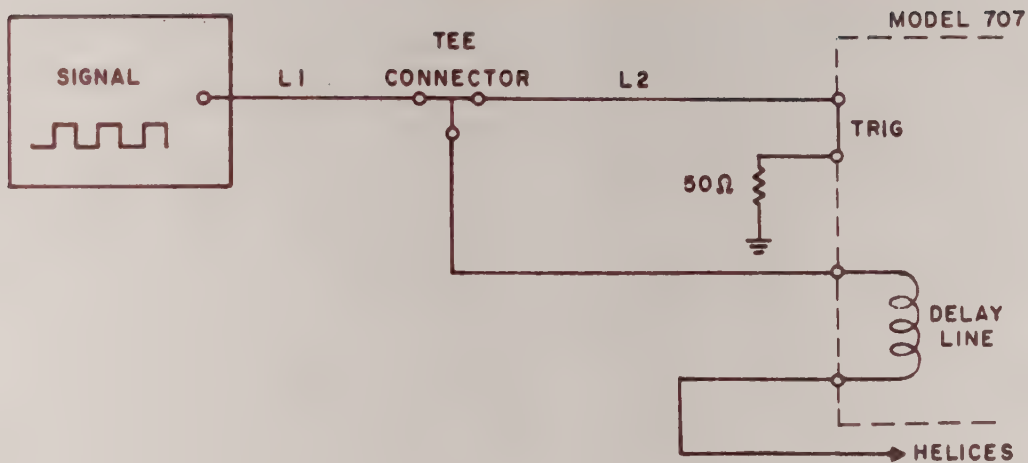


Fig. 20. Triggering method C.

5.3 SIGNAL APPLICATION TO HELICES

Once the Model 707 has been triggered and the signal has been suitably delayed as discussed in Section 5.2, there are a number of ways in which the signal can be applied to the deflection helices. These methods are illustrated in Figs. 21, 22, and 23. When using the arrangement of Fig. 22 it may be necessary to provide a d-c return path for the signal.

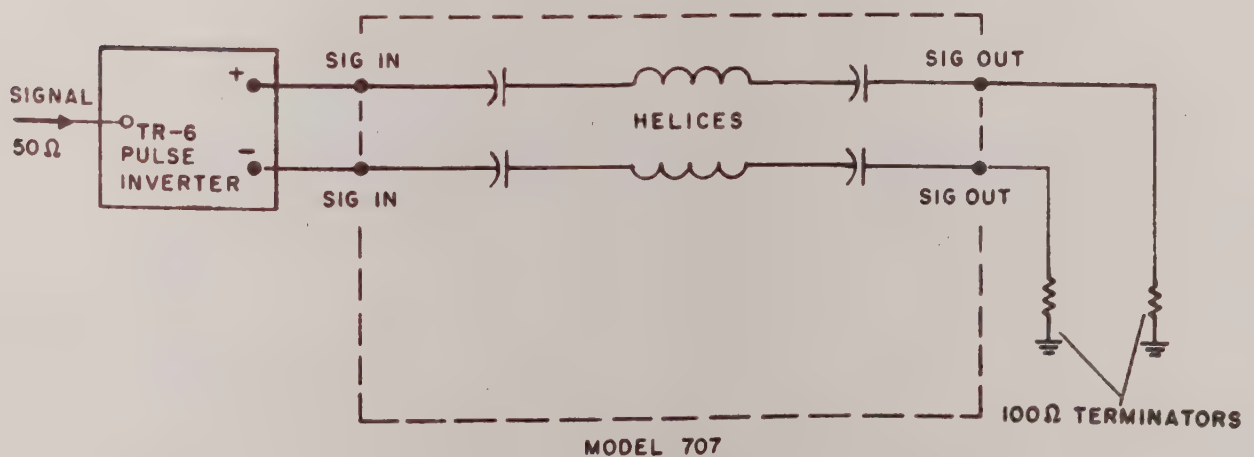


Fig. 21. Push-pull signal application.

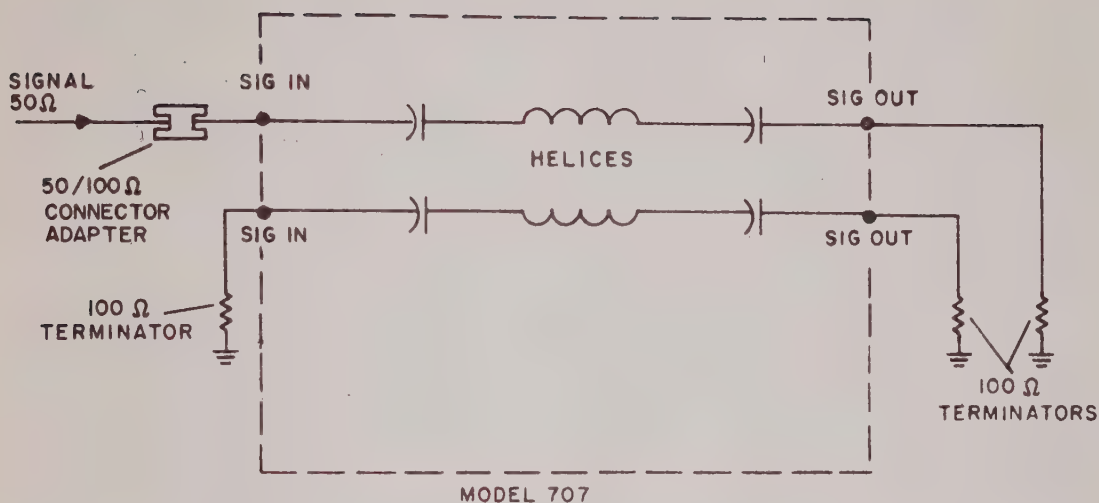


Fig. 22. Single-ended signal application with transition coupling.

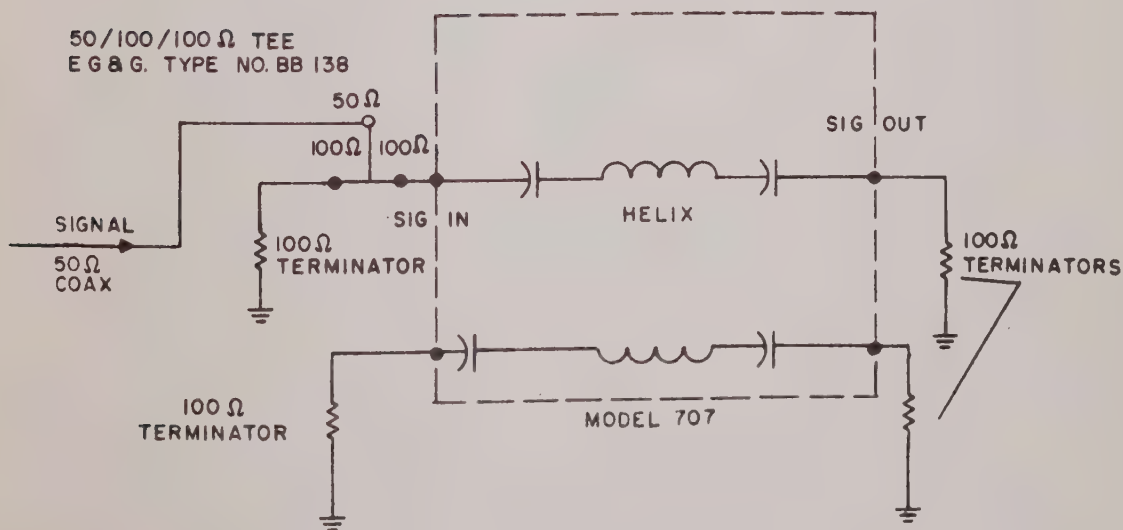


Fig. 23. Preferred single-ended method.

Note that signals need not always be terminated at the oscilloscope after passing through a helix if the signal is to be used elsewhere for another purpose. For example, if a simultaneous display of two signals is desired, or if the turn-on or delay of a device is to be measured, the system shown in Fig. 24 can be employed.

5.4 OTHER METHODS

The systems described in Section 5 serve only as a guide to many possible methods of triggering and signal amplification. The two independent deflection helices, delay lines, and a feed-through trigger make possible a great variety of arrangements.

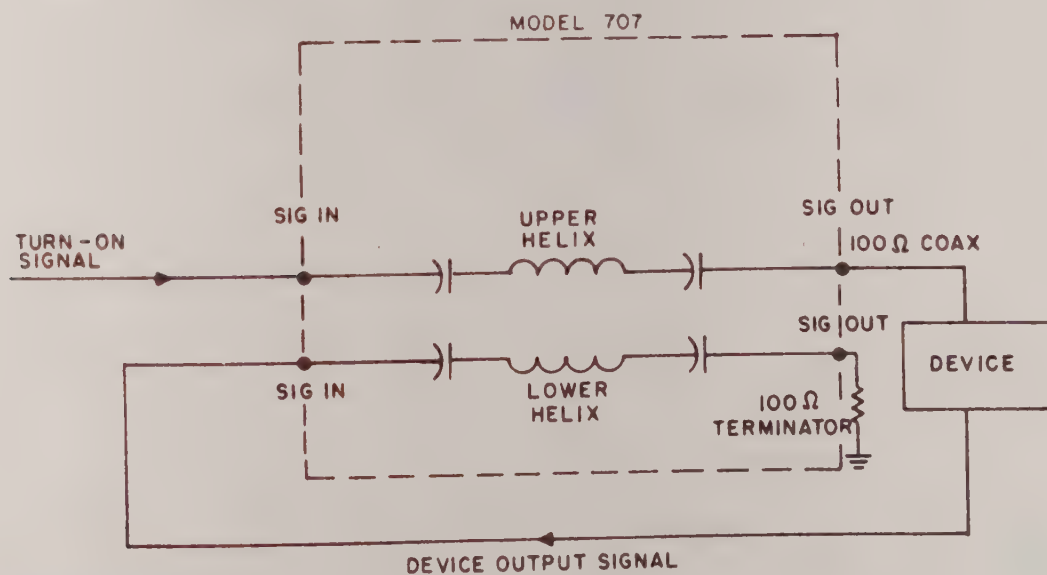


Fig. 24. Unterminated helix.

SECTION 6

MAINTENANCE

No special tools are required to service the EG&G Model 707 Oscilloscope. A long screwdriver will be found convenient for the removal of some of the subassemblies and the adjustment of sweep speeds.

Note that each subassembly is a complete unit and was designed to be easily removed from the scope for servicing. The subassemblies are interconnected by cables and connectors. As noted earlier the PS-1 and PS-5A power supplies are sealed units and must be replaced as units should they fail. If the KRT becomes defective it is recommended that the entire Indicator chassis be returned to the factory. Factory equipment and procedures are necessary for proper alignment.



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